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# A REVISION OF THE GENUS ARHYTHMORHYNCHUS

WITH DESCRIPTIONS OF TWO NEW SPECIES FROM NORTH  
AMERICAN BIRDS \*

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## INTRODUCTION

When Lühe created the genus *Arhythmorhynchus* (1911:47) he assigned to it but one species *A. frassoni* (Mol.). The following year in publishing the results obtained from a study of four immature specimens of *Echinorhynchus invaginabilis* von Linstow Lühe (1912:283) ascribed that species to the genus *Arhythmorhynchus* and in the same article accepted two American species, *Echinorhynchus uncinatus* Kaiser and *E. trichocephalus* R. Leuckart, as agreeing with his definition of the genus *Arhythmorhynchus*. Of these four species belonging to this genus but one is well known, namely, *A. frassoni* (Mol.). For the two American species not even the host is known, and while Kaiser (1893) has given minute details regarding the hooks of these two species, data concerning the embryos and many other points which are essential for a complete specific diagnosis are entirely wanting. Consequently it seems that concerning some of the points in the definition of the genus data are available for a single species only. It is not surprising that a generic diagnosis based upon the study of a very small number of species might later require emendation to permit including within the same genus species of obviously close relationship. Especially is this true in groups of parasites, such as the *Acanthocephala*, in which the organization of the body has been reduced to its simplest terms through perfect adaptation to the parasitic existence; for this same reduction eliminates large groups of organs and structures which in nonparasitic forms afford additional characteristics of diagnostic value.

Recently the writer (Van Cleave, 1913) found it advisable to emend the definition of the genus *Neoechinorhynchus* to permit including within it five species which were unknown to the founder of the genus. Similarly now after a study of new materials including two new species closely related to *Arhythmorhynchus frassoni* (Mol.) and *A. invaginabilis* (von Linst.) the writer has found it imperative to modify Lühe's original description of the genus *Arhythmorhynchus* (Lühe, 1911:47) to prevent exclusion from this genus of forms which under a natural

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system of classification could not be granted independent generic rank. The materials upon which the present study has been made were collected by Mr. Albert Hassall and deposited in the Collections of the U. S. Bureau of Animal Industry. Both species are represented in the collection by numerous fully mature individuals so that a complete study of the specific characteristics has been possible in both species. These new forms were found to deviate from Lühe's description of the genus *Arhythmorhynchus* in the following particulars: (1) the shape of the body; (2) the location of the testes with reference to the two regions of the body proper described by Lühe; (3) the shape of the membranes surrounding the hard-shelled embryos in the body cavity of the female. In the estimation of the writer these are placed in the order of their relative significance, the least significant first.

As Lühe has pointed out, the anterior region of the body in members of the genus *Arhythmorhynchus*, which in some species is an inflated oval region standing out in contrast to the smaller cylindrical posterior region (Figs. 1 and 4) contains relatively large numbers of subcuticular nuclei while the posterior region is devoid of subcuticular nuclei. Simple body shape has been so long recognized as a variable quantity by those working with *Acanthocephala* that little emphasis may justly be given it alone. However, when body shape has as an accompanying feature distinctive structural characteristics emphasis may be placed upon the structure as of diagnostic value though broad range of variation may occur in the gross outer form in which the structure finds expression. Therefore, in defining the genus *Arhythmorhynchus*, emphasis should be placed upon the difference in structure between anterior and posterior regions of the body rather than upon the difference in shape of these two regions, for the structure is constant in all species which have been examined though the body form is widely variable. For the males of this genus Lühe has specified that the testes occur in the anterior swollen region of the body (Fig. 1). Suspended as they are in the genital ligament running backward through the body cavity from the base of the proboscis sheath and with no intimate relationship to the body wall little of generic value may be placed upon the exact location of these organs in the body cavity. In one species at least (Fig. 4) the testes do not lie in the swollen region of the body as indicated in Lühe's diagnosis of the genus, but are located distinctly posterior to that region. The third point of difference, the shape of the embryonic membranes, presents the most radical point of divergence in the species under consideration from the original description of the genus. Lühe throughout his classification of the *Acanthocephala* has emphasized the importance of shape of the embryos and structure of their coverings as of marked diagnostic value. For *Arhythmorhynchus* he has specified in his characterization of that genus the presence of

three fully concentric membranes surrounding the embryo within the body cavity of mature females. His observations upon the embryos of *A. frassoni*, the only species of the genus for which sexually mature individuals were at that time known, corroborated the earlier record of de Marval (1904, Fig. 55) for the embryos of the same species. However in *A. brevis* and *A. pumilirostris* the writer has found two species which, though agreeing with Lühe's definition of the genus in all other essential characteristics, present a marked contrast in the structure of the embryos. In each of these species numerous fully mature females have been examined with the unvarying result of disclosing hard-shelled embryos in which the middle membrane has an outpocketing at each pole (Figs. 10 and 12).

In view of the foregoing details, wherein the two newly described species fail to agree with the original definition of the genus, two possibilities present themselves: either (1) a new genus should be established for these two species; or (2) the definition of the genus *Arhythmorhynchus* should be modified so as to include these forms. To the writer it seems unwise to create a new genus for forms which differ from an existing genus by but a single point of essential distinction: namely the shape of the membranes surrounding the embryos. Especially does this seem uncalled for in the case under consideration in which up to the present time, embryos were known for but a single species. Therefore it appears expedient to recast the definition of the genus *Arhythmorhynchus*.

#### REVISED DIAGNOSIS OF THE GENUS ARHYTHMORHYNCHUS

Acanthocephala with a spindle-shaped proboscis upon which the hooks are arranged not in radial but in bilateral symmetry since those on the dorsal and ventral surfaces of the same individual differ, though in varying degrees in different species. Anterior region of body sharply differentiated from posterior region in structure of body wall, especially in the presence of nuclei in the subcuticula of anterior region only. Portion of the anterior region of body proper spined. Spines entirely wanting on neck and on posterior region of body proper. Proboscis sheath a double-walled muscular sac inserted at the base of proboscis. Central nervous system near center of proboscis sheath. Cement glands very long, slender. Embryos in body cavity of female elongated oval with three membranes, all concentric or the middle one with an outpocketing at each pole. Sexually mature in the intestine of birds.

#### ARHYTHMORHYNCHUS BREVIS NOV. SPEC.

Body in both sexes with distinct oval enlargement comprising about anterior half. Posterior end distinctly smaller, elongated, cylindrical. Females 6 to 12 mm. long; maximum thickness 3 mm.; diameter of

posterior region about 1 mm. Males, 5 to 6 mm. long; maximum thickness, 1 to 1.5 mm.; diameter of posterior region, 0.5 to 0.75 mm. Neck naked, retractable, tapering toward proboscis, not sharply set off from body, 0.35 to 0.55 mm. long. Body for short distance just back of neck irregularly set with small number of spines 0.012 mm. long. Proboscis elongated with conspicuous expansion near center, 0.665 mm. long, 0.230 mm. in diameter at base, 0.190 mm. at tip, 0.340 mm. at center. Proboscis armed with eighteen longitudinal rows of hooks, usually fifteen in a row. Basal hooks nearly straight, slender, 0.047 mm. long. Heaviest hooks near middle of proboscis 0.041 to 0.047 mm. long, on ventral surface slightly larger than on dorsal. Hooks at tip slender, recurved, 0.047 mm. long. Cement glands long, narrow. Testes oval, slightly overlapping one another, in swollen part of body. Embryos 0.076 to 0.100 mm. by 0.024 to 0.030 mm. Middle of three shells of embryos heavy, with a rounded swelling at each pole. Host *Botaurus lentiginosus* (Montag.), intestine. Type locality Baltimore, Md., U. S. A.; Cotypes in collection Bureau of Animal Industry, Washington, D. C., Catalog No. 6302; and in the Helminthological Collection of the Department of Zoology, University of Illinois, Urbana, Catalog No. 16, 165.

The structure of the body wall in the genus *Arhythmorhynchus* presents numerous anomalies when compared with conditions found in other genera of *Acanthocephala*. The writer has made a study of some of these points, especially in the species *A. brevis*, the results of which follow. Lühe (1911: 47) has called attention to the peculiar distribution of the subcuticular nuclei in this genus and incidentally in a vague manner has referred to other differences between the anterior and posterior regions of the body. Figure 11 shows the shape, structure, and location of the subcuticular nuclei in a longitudinal section through the anterior region of a specimen of *A. brevis*. The entire subcuticula is a peculiar structure, presenting an appearance unparalleled in any other genus of *Acanthocephala*. In the anterior region of the body there may be easily recognized beneath the cuticula (*c*) a region in which small fibrillae run both longitudinally and radially (*sc1*). An intermediate more heavily granular zone (*sc2*) separates this region from the region of radial fibers (*sc3*) in which the subcuticular nuclei (*sn*) are contained. This last region, which Kaiser (1913, Plate 1, Fig. 1) in *Gigantorhynchus hirudinaceus* called the hypoderm, is bounded on its inner surface by a layer of circular muscular threads (*cmt*).

The longitudinal muscular layer in the anterior part of the body shows some most striking deviations from conditions usually found in the body musculature of *Acanthocephala*. The presence of large nuclei (*mn*) in, and of numerous finger-like fiber-bundles (*mf*) imbedded in an undifferentiated cytoplasmic envelop (*uc*) suggest a resemblance to

the nematode musculature. But this can be scarcely more than a suggestion since the orientation of the fibers is the opposite of that characteristic of the nematodes. Figure 11, a longitudinal section of *A. brevis*, shows these fiber-bundles in a position comparable to the view obtained in a cross section of a nematode. Though this agreement in fundamental structure of the muscle cells may indicate a relationship between the Acanthocephala and the Nematoda, yet the confusion in the arrangement of the fibers prevents ascribing to the argument any great phylogenetic importance.

Lühe in his characterization of the genus *Arhythmorhynchus* commented upon the slight development of the lacunar system of the subcuticula. In Figure 7, the writer has shown a portion of a tangential section through the subcuticula of *A. brevis*. A longitudinal canal (*lc*) is shown in its characteristic relationship with a circular canal (*cc*). In this species, at least, the canal system is well developed, though the extent and complexity of the subcuticular layer tend to make it inconspicuous.

In the posterior region of the body the body-wall presents its broadest departure in *A. brevis* from the conditions usually found in other genera. Here, as has been stated before, there are no subcuticular nuclei. The regions of the subcuticula (Fig. 8) agree in arrangement and general structure with those previously described for the same layer in the anterior part of the body. However, between the double row of circular muscle threads (*cmt*) and the body cavity is interposed a series of structures which are evidently modified continuations of the muscular system described for the anterior region of the body. In a longitudinal section, or in an optical section of a well prepared whole mount, this modified part has the appearance of a series of triangular elevations (*tr*) with the base of each triangle directed toward the layer of circular muscle threads. From the apex of each of these triangles is given off a fine membrane (*m*) which runs inward toward the longitudinal muscle sheath. Each of the triangular elevations is pierced by a canal (*ca*) about 0.025 mm. in diameter. These triangular ridges occupy only about one fourth the region between the circular muscular threads and the muscle sheath lining the body cavity. Most of the intervening space is open cavity intercepted at irregular intervals by very thin membranes (*ms*) of another series which do not take their origin or have their insertion in the triangular ridges. The open spaces between the membranes are in communication with the central body cavity as is especially shown by the presence within the chambers of large numbers of eggs and embryos (*e*) in various stages of formation.

Some of the muscles within the body cavity show a peculiar striation. Figure 6 represents a single fiber of one of the retractor muscles

greatly magnified. Regions of dark striations (*st*) alternate with bands of nonstriated structure, while the nucleus (*n*) is in a mass of undifferentiated cytoplasm at one side of the fiber.

ARHYTHMORHYNCHUS PUMILIROSTRIS NOV. SPEC.

Body of males and immature females with slight enlargement comprising about anterior fifth. Gravid females with posterior region of body enlarged, cylindrical, with irregularly distributed swellings. Females up to 30 mm. long. Maximum diameter fully gravid female, slightly posterior to middle of body, 1.5 mm.; diameter anterior region 0.9 mm. Neck naked, retractile, tapering toward proboscis; in size not sharply set off from body. Body for short distance behind neck set with small spines, 0.012 to 0.020 mm. long. Proboscis elongated, with conspicuous swelling near center; length 0.450 mm.; maximum breadth 0.180 mm.; breadth at tip 0.095 mm., at base 0.114 mm. Proboscis armed with sixteen longitudinal rows of hooks with fourteen or fifteen hooks in a row. Basal hooks nearly straight, thorn like, usually 0.035 mm. long. Heaviest hooks on ventral surface near middle of proboscis 0.030 mm. long. Hooks at tip slender, recurved, 0.030 to 0.035 mm. long. Cement glands in male extremely attenuated. Testes contiguous in region behind anterior swelling of body. Embryos 0.065 to 0.089 mm. long; 0.018 mm. wide; with three membranes, the middle one with an outpocketing at each pole.

Host *Botaurus lentigenosus* (Montag.), intestine. Type locality Washington, D. C. Cotypes in collection of Bureau of Animal Industry, Washington, D. C., Catalog No. 2076; and in the Helminthological Collection of the Department of Zoology, University of Illinois, Catalog No. 16, 166.

In its microscopic anatomy this species closely resembles that given for the preceding species. Figure 13, an optical section of *A. pumilirostris*, indicates the general distribution of the two types of subcuticular structure discussed under the morphology of *A. brevis*, while Figure 12 shows a single hard shelled embryo.

INTERRELATIONSHIPS OF THE SPECIES

Upon the basis of the characteristics of the proboscis hooks alone there is an indication of a natural division of this genus into two subgroups which make comparisons between species fairly certain even though the essential diagnostic facts for some species are not all known. One group consists of those species whose members possess a few extremely large hooks at the middle of the ventral surface of the proboscis; *A. frassoni* and *A. trichocephalus* fall within this group. In the second group the midventral hooks are but slightly larger than the

midlateral and middorsal hooks; to this belong *A. invaginabilis*, *A. brevis*, *A. uncinatus*, and *A. pumilirostris*. *A. brevis* and *A. pumilirostris* may be separated from *A. invaginabilis* upon the basis of the number of longitudinal rows of hooks upon the proboscis. For the last named species Lühe (1912:287) found twenty-two to twenty-four longitudinal rows of hooks. Eighteen are found in *A. brevis* and sixteen in *A. pumilirostris*. The separation of *A. uncinatus* is most sharply shown in a comparison of the size of the hooks. Kaiser (1893:15) found hooks upon the proboscis of *A. uncinatus* ranging from 0.056 to 0.120 mm. long while in *A. brevis* the writer has found the range in size of hooks to be from 0.030 to 0.047 mm., and in *A. pumilirostris* the longest hooks are 0.035 mm. long. *A. brevis* and *A. pumilirostris* are most readily separable one from the other by the fact that the former has the larger proboscis with eighteen longitudinal rows of hooks, while the latter has but sixteen longitudinal rows of hooks upon a much smaller proboscis.

At the end of his work on the Acanthocephala of the fresh waters of Germany, Lühe (1911:53) has considered a number of species which were insufficiently known to permit of classification in his system with certainty. Among these is a species *E. striatus* Gze. for which he has mentioned an apparent relationship with the genus *Corynosoma* through the shape of the embryos. Since this is the sole point where the present writer found the two species *A. brevis* and *A. pumilirostris* to differ from Lühe's description of the genus *Arhythmorhynchus* and since the figures and description of *E. striatus* agree also with that genus the writer can see no objection to including the species *striatus* within the genus *Arhythmorhynchus* as emended in the present paper.

KEY TO THE SPECIES OF ARHYTHMORHYNCHUS REPORTED FROM  
NORTH AMERICA

- 1 (2) Hooks on mid-ventral surface of proboscis conspicuously larger than any others.....*A. trichocephalus* (R. Leuckart)
- 2 (1) Hooks on ventral surface of proboscis not conspicuously larger than on other surfaces.....3
- 3 (4) Longest hooks more than 0.100 mm....*A. uncinatus* (Kaiser)
- 4 (3) Longest hooks not more than 0.050 mm.....5
- 5 (6) Proboscis with sixteen longitudinal rows of hooks; embryos 0.065 to 0.089 mm. long and 0.018 mm.wide.....  
.....*A. pumilirostris* Van Cleave
- 6 (5) Proboscis with eighteen longitudinal rows of hooks, embryos 0.076 to 0.100 mm. long, and 0.024 to 0.030 mm. wide.....  
.....*A. brevis* Van Cleave



## SUMMARY

Two new species of Acanthocephala from the intestine of *Botaurus lentiginosus* show close relationship to *Arhythmorhynchus frassoni*. They fail to agree with Lühe's definition of the genus *Arhythmorhynchus* in: (1) shape of the body; (2) location of the testes; (3) shape of the membranes surrounding the hard-shelled embryos. The original characterization of the genus is emended to include these forms which possess every other essential characteristic of the genus.

## LITERATURE CITED

- Kaiser, J. E. 1893. Die Acanthocephalen und ihre Entwicklung. Biblioth. Zool., 7: 1-136. 1913. Die Acanthocephalen und ihre Entwicklung. Leipzig, 66 pp.
- Linstow, O. von. 1902. Beobachtungen an neuen und bekanten Helminthen. Arch. mikr. Anat., 60: 217-232.
- Lühe, M. 1911. Die Süßwasserfauna Deutschlands, Hefte 16, Acanthocephalen. Jena; 116 pp. 1912. Zur Kenntnis der Acanthocephalen. Zool. Jahrb., Suppl. 15; 1: 271-306.
- Marval, L. de. 1905. Monographie des acanthocéphales d'oiseaux. Rev. suisse de zool., 13: 195-387.
- Van Cleave, H. J. 1913. The Genus *Neorhynchus* in North America. Zool. Anz., 43: 177-190.

## EXPLANATION OF PLATES

All figures drawn from permanent, stained, balsam mounts with the aid of a camera lucida.

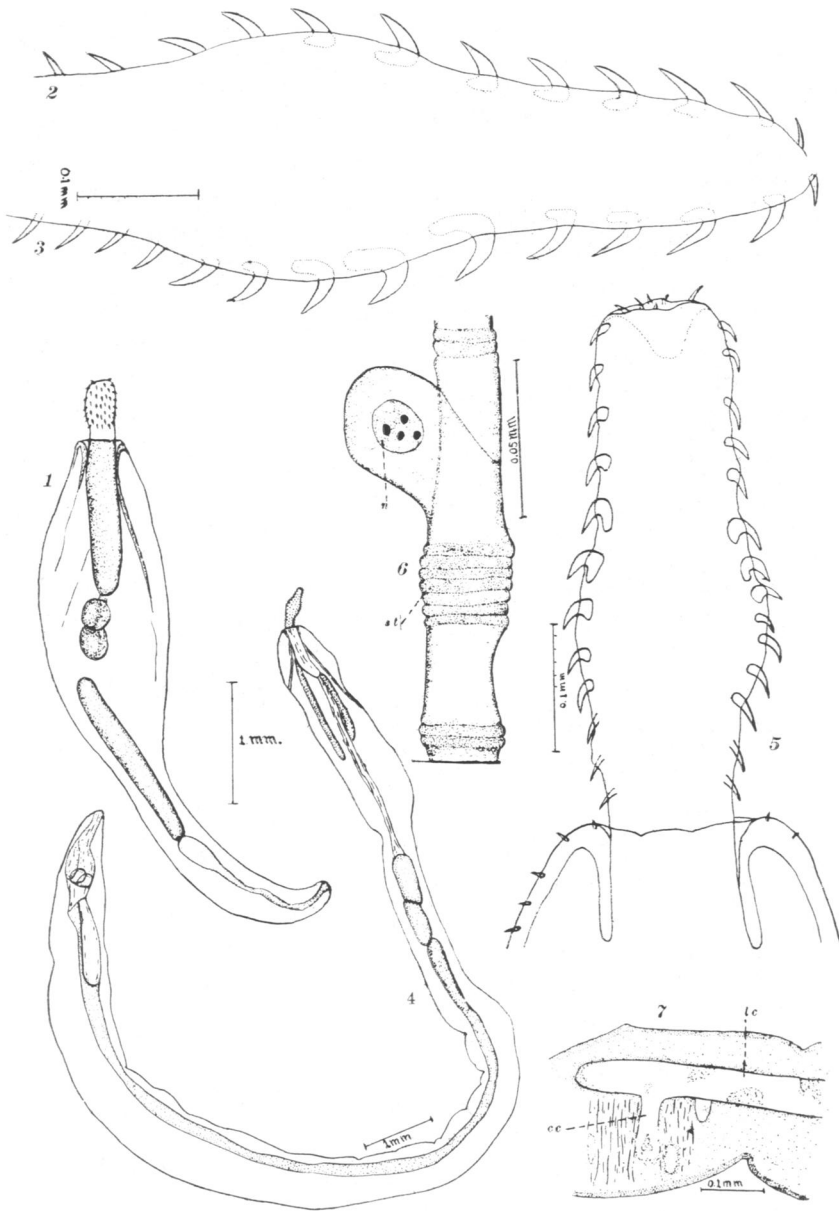
## PLATE 1

- Figs. 1 to 3.—*Arhythmorhynchus brevis* nov. spec.
- Fig. 1.—Immature male, entire.
- Fig. 2.—Profile, dorsal surface, proboscis of mature male.
- Fig. 3.—Profile, ventral surface, same proboscis as in Figure 2.
- Figs. 4 and 5.—*Arhythmorhynchus pumilirostris* nov. spec.
- Fig. 4.—Male, entire.
- Fig. 5.—Profile, anterior end of body of same individual as shown in Figure 4.
- Fig. 6.—Proboscis hooks same magnification as Figures 2 and 3 of *A. brevis*.
- Figs. 6 and 7.—*A. brevis*.
- Fig. 6.—Muscle fiber from one of the retractor muscles.
- Fig. 7.—Portion of tangential section through cuticula and subcuticula showing relations of longitudinal (*lc*) and circular (*cc*) canals.

## PLATE 2

- Figs. 8 to 11.—*A. brevis*.
- Fig. 8.—Portion of body wall in posterior region. Sagittal section. For details see text.
- Fig. 9.—Spines from anterior part of body wall.
- Fig. 10.—Embryos from gravid female.
- Fig. 11.—Portion of body in anterior region. Sagittal section. For details see text.
- Figs. 12 to 14.—*A. pumilirostris*.
- Fig. 12.—Embryos from gravid female.
- Fig. 13.—Anterior end of body, optical section, showing relative differentiation and distribution of subcuticula.
- Fig. 14.—Spines from anterior part of body.

PLATE 1



# PLATE 2

